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## Increasing innovativeness of SMEs in peripheral areas through international networks? The case of Southern Italy\*

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**Abstract.** Strengthening innovation capacity of European small and medium enterprises (SMEs) by means of their participation in the Sixth (FP6-SME) and Seventh (FP7-SME) Framework Programmes was an important objective of the European Union policies. Since SMEs form the backbone of the Italian economy, their strong presence in an international network such as the one fostered by the European Union represents a great opportunity, particularly for firms located in southern Italy – the marginal macro-area of the country in terms of innovation – to increase their competitiveness. Based on the major literature on topics such as knowledge exchange, innovation networks and disparities, and on descriptive statistics and a cluster analysis in a dynamic perspective, our study aimed to assess the actual intra-regional, extra-regional and transnational links established by the Italian SMEs and public research establishments (PREs). In the next step we assessed whether knowledge flows fostered by the FP6-SME and FP7-SME were mainly concentrated in the traditionally winning macro-regional areas (North and Center) or led to more widespread benefits in favor of SMEs located in the marginal South. The findings of our study revealed a very limited number of connections – with a related weak knowledge exchange – involving the southern regions, implying a reinforcement of innovation activities in the traditionally most dynamic industrial areas of the country.

### 1 Introduction

The European Union (EU) confers a key role to micro, small and medium enterprises (SMEs) and considers them the engines of the European economy as well as essential sources of jobs and creators of innovation and an entrepreneurial spirit. Furthermore, SMEs are considered by the EU as crucial economic entities to foster competitiveness and employment. According to the EU, Horizon 2020 actively supports SMEs by providing both direct financial and indirect supports to increase their innovation capacity.

In this respect, both the Sixth (FP6) and Seventh (FP7) Framework Programmes already included themes (FP6-SME and FP7-SME) specifically created to benefit this type of organization with the objectives to “strengthen the innovation capacity of European SMEs and their contribution to the development of new technology-based products and markets, bridge the gap between research and innovation by helping SMEs outsource

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research, increase their research efforts, extend their networks, better exploit research results and acquire technological know-how" ([European Commission 2012](#)).

Specifically, SMEs form the real backbone of the Italian economy: 99.9% of the Italian enterprises have fewer than 250 employees and 95% have fewer than 10 employees ([ISTAT 2013b](#)).

According to various studies and reports ([ISTAT 2013a](#), [Svimez 2015](#)), the fragmentation of the Italian economic-production framework in a myriad of micro firms and SMEs is precisely one of the major factors hindering the level of productivity and the low degree of innovation in the country as a whole and particularly in the Southern regions ([Wired & Cotec 2009](#), [Svimez 2015](#)). The Italian socio-economic fabric is characterized by evident and long-lasting disparities between the northern and central regions (which are to varying extents the most advanced areas of the country) and the southern ones ([A'Hearn, Venables 2011](#)).

Most industrial activities in Italy are historically concentrated in the North, particularly in the so-called "Industrial Triangle" of Lombardy, Piedmont and Liguria, whereas some northern and central regions such as Veneto, Emilia Romagna, Tuscany and Marche saw the flourishing implementation of several dense and strongly related SME-based Marshallian industrial districts in the 1970s and 1980s. They contributed to create the so-called "Third Italy", a successful sociological definition which distinguishes this peculiar form of industrialization from the "First Italy" (the industrial heartland of the Northwest) and the "Second Italy" (the marginal Southern regions) ([Bagnasco 1977](#), [Trigilia 1986](#), [Scott 1988](#), [Sforzi 1989](#)).

In the last fifteen years several indicators (average annual growth, unemployment rate, lack of public and foreign direct investments, etc.) have negatively characterized the socio-economic performances of Italy, whose cumulative growth (20.6%) in the period 2000-2013 was the lowest in the euro area (37.3%), even lower than Greece (24%).

In this general weak framework the southern regions have mostly suffered the effects of the economic crisis started in the 2008, compared with the other two macro-areas of the country (North and Center). Factors such as the extremely weak production system – causing very low competitiveness and productivity – and the lack of human capital caused by significant migrations of skilled workers to other areas of the country or even abroad emphasize the socio-economic divergence in the Italian development path. The real risk for the southern regions is that a cyclical crisis could turn into permanent underdevelopment ([Svimez 2015](#)).

Starting from this perspective, we analyzed all the projects involving at least one Italian organization (i.e. SME or public research establishment, PRE) funded under the FP6-SME and FP7-SME in order to determine the actual presence of organizations located in a peripheral area in terms of innovation (e.g. Southern Italy) within the innovation networks created under the two latest FPs.

Specifically, our aim was to answer the following research questions: Which is the actual presence of SMEs and PREs located in the eight southern Italian regions (Abruzzo, Apulia, Basilicata, Calabria, Campania, Molise, Sardinia and Sicily) in the two latest FPs specifically devoted to SMEs? And did these SMEs benefit from the knowledge flows created by the collaborations encouraged by the aforementioned research programs?

The dataset we use focuses on projects funded by the EU. The dataset covers a period of 12 years (divided in two time-lapses, 2002-2006 for FP6, and 2007-2013 for FP7), with these EU-funded projects serving as some of the best environments to create and disseminate research results and knowledge ([European Commission 2007](#)).

The theoretical basis for the present case study has been provided by this latter consideration and by the findings of several previous studies which stress the importance for companies located in peripheral areas to create and strengthen connections with near and distant international partners ([Bathelt et al. 2004](#), [Meier Zu Köcker et al. 2011](#), [Fitjar, Rodríguez-Pose 2011a,b](#), [Gust-Bardon 2012](#)), in order to successfully produce innovation and generate beneficial "network effects" ([Autant-Bernard et al. 2007](#)).

These studies suggested that knowledge exchange is a critical factor in innovation dynamics and a very good proxy to capture the effects of industrialization by adopting a spatial perspective.

Therefore, following the indications of the [European Commission \(2013\)](#) and a previous study regarding the impact of innovation network dynamics on regional re-industrialization processes ([Calignano, Quarta 2015](#)), we hypothesize that the presence of extremely centralized relational clusters in the EU research network is symptomatic of a strengthening in the polarization of innovation activities in the winning regions, whereas more diffuse network structures bring more widespread benefits in favor of SMEs located in peripheral areas in terms of innovation ([European Commission 2013](#)).

A dynamic approach (i.e., considering two distinct periods related to the two latest FPs<sup>1</sup>), descriptive statistical techniques and cluster analysis were adopted for processing the data concerning the collaboration established by the Italian SMEs and PREs throughout the FP6-SME and FP7-SME.

The paper is organized as follows: In the next section, the major literature referring to the main topics tackled in the article is reviewed to provide the theoretical background of the study; in Section 3 the methodology adopted for the study is outlined, by illustrating also the main characteristics of the dataset we used and justifying its choice; in Section 4 (divided in four different sub-sections) the results of the case study are broadly illustrated; finally, in Section 5 the major findings of the study are discussed and the conclusions presented.

## 2 Knowledge, innovation, networks and disparities: A theoretical framework

In recent years innovation networks and knowledge exchange became increasingly central topics in innovation studies with a spatial background (i.e., [Frenken 2000](#), [Simmie 2003](#), [Bathelt et al. 2004](#), [Hassink 2005](#), [Asheim et al. 2007](#), [Autant-Bernard et al. 2007](#), [Hagen 2008](#), [Binz, Truffer 2011](#), [Marrocu et al. 2013](#)). The great interest towards these subjects sprang especially from the channels and mechanisms through which innovation is nowadays created, shared and diffused.

In fact, the advent of the so-called knowledge-based economy ([Brinkley 2006](#)) in the current era of globalization has led to a sharp transition from a “closed” to a new “open” model of innovation ([Chesbrough 2003](#)).

In a nutshell, in the old model of closed innovation, firms used to generate the ideas that they intended to develop, manufacture and commercialize relying exclusively on their own labs and resources and by trying to employ the most skilled workers on the job market. Furthermore, these innovative companies defended the advantage deriving from their new inventions from the risk posed by competitors ‘decoding’ the product and using the outsourced and materialized knowledge by means of intellectual property rights. Finally, the virtuous cycle of innovation was driven by the commercial success and profits deriving from the new inventions, leading to new investments in R&D and additional breakthrough discoveries.

However, the advent of globalization led to significant changes in innovation and its related dynamics – such as knowledge exchange – in recent decades ([Storper 1999](#)).

In the current mutable global economic scenario companies are hardly able to take high risks in terms of R&D or carry out by themselves extensive research leading to new products with an uncertain commercial success. Furthermore, two other factors have determined the transition from a closed to an open model of innovation in most industries: First, the higher mobility of knowledge workers made it increasingly difficult to control proprietary ideas and expertise for companies; and secondly, the rise of new successful

<sup>1</sup> Several changes occurred in the transition from the FP6 to the FP7 including a larger budget, a longer duration (increased from 5 to 7 years) and a new mechanism aiming to enhance long-term private-public partnerships (i.e. the so-called Joint Technologies Initiatives). Furthermore, an accentuated international dimension and a special attention devoted to SMEs (including a package close to 1 billion euros) are both features of the more recent FP. However, even though all these relevant differences certainly influenced the number of regional organizations in terms of overall participations, they did not affect the dynamic approach we adopted and the results of our comparison. This consideration is based on the fact that our statistical and cluster analyses were carried out within each FP and that the aforementioned changes pertained indiscriminately to all the organizations which participated to either the FP6 or FP7.

firms which were supported by the growing availability of private venture capital financing spilling out from the large companies' research labs.

According to the open innovation model, the boundaries between companies and their surrounding environments are porous and companies develop their ideas both within and outside them, by implying new ways to create value and a new logic embracing external ideas and knowledge in conjunction with internal R&D ([Chesbrough 2003](#)).

These considerations at the management level are particularly interesting when a spatial perspective is adopted by suggesting a relational nature and a collaborative dimension of innovation which involves networks of actors at different levels and distances ([Balland et al. 2015](#)).

Knowledge exchange determined by collaborations among organizations at various geographical scales can be considered an essential prerequisite in dynamics leading to innovation ([Calignano, Quarta 2015](#)).

Even though spatial proximity is still perceived as a competitive advantage ([Gust-Bardon 2012](#)) and geographical proximity remains a critical factor in favoring knowledge exchange among closely located organizations ([Sonn, Storper 2008](#)), at the same time various studies have highlighted how other forms of proximity (such as cognitive, organizational, social and institutional proximities: [Boschma 2005](#)) and long-distance collaborations increasingly matter and have a positive influence in innovation dynamics both at the regional and national levels ([Frenken 2000](#), [Asheim, Isaksen 2002](#), [Lagendijk, Lorentzen 2007](#), [Fitjar, Rodríguez-Pose 2011a,b](#)).

In other words, in the last few decades innovation spaces have been dramatically redesigned and characterized by significant changes in the production and diffusion of knowledge ([Scherngell, Barber 2010](#)). These changes led to a higher number of long distance collaborations and partnerships determining a related increasingly swift importance of innovation networks at the transnational level ([Wagner, Leydesdorff 2005](#), [Autant-Bernard et al. 2007](#), [Maggioni, Uberti 2011](#)).

These latter aspects are relevant especially for firms located in peripheral areas, since they can take advantage from R&D inputs and knowledge flows from both adjacent ([Moreno et al. 2005](#), [Rodríguez-Pose, Crescenzi 2008](#)) and distant ([Asheim, Isaksen 2002](#), [Lagendijk, Lorentzen 2007](#), [Fitjar, Rodríguez-Pose 2011a,b](#)) partners and regions. In other words, changes in the global economy have made the connections among organizations at the international level increasingly prominent by highlighting contextually the benefits brought by their internationalization. Similarly, the establishment of strong links between distant organizations with complementary strengths is one of the best ways for businesses to obtain access to more recent technology, best skills and most promising markets ([Meier Zu Köcker et al. 2011](#)).

In sum, regional firms should aim at both learning from each other and developing sound relationships with partners located in other geographical areas around the world in order to improve their innovation capabilities ([Gust-Bardon 2012](#)).

The innovation activities of the SMEs located in Southern Italy – the economic entities and macro regional areas this paper refers to – are characterized by a very weak institutional, socio-economic and industrial fabric and are negatively affected by the loss-making historical trajectories of the area. The active and successful participation of these organizations located in disadvantaged or peripheral regions in national or international research programs is negatively influenced precisely by the aforementioned aspects ([Calignano, Quarta 2015](#)).

More broadly, the concepts just expressed take the name of 'path dependence' and refer specifically to an open system evolving in ways shaped by its past development paths ([Boschma, Martin 2010](#)) which can either negatively or positively affect the socio-economic fabric of an area.

However, even though less developed regions certainly face difficulties in changing their innovation process models and in breaking out their path dependence, economic scenarios are subject to substantial changes ([Boschma, Martin 2007](#)), and in the past the adoption of different paths was possible in some regions or countries and it will be possible for less developed ones in the future ([Pylak 2015](#)).

With regard to old industrial areas, [Hassink \(2010, p. 452\)](#) argues that regional lock-in

“refers to a set of interrelated lock-ins that manifest themselves at the regional level, but are influenced and affected by both intra-regional and extra-regional factors”. One of these factors is the lack of renewal in the past development paths which firms can successfully tackle by focusing on innovation and diversification.

With this empirical evidence and these theoretical premises as our basis, we looked at the projects funded under the two latest FPs with the aim to determine the actual presence and the connections created by the Italian SMEs and PREs at the intra-regional, extra-regional and transnational levels.

As stated above, we argue that a network characterized by more diffuse structures brings more widespread benefits in favor of SMEs located in peripheral areas, whereas the presence of centralized networks is the symptom of a reinforced polarization in innovation activities in the most advanced areas of the country ([European Commission 2013](#), [Calignano, Quarta 2015](#)).

A recent study was carried out in a similar vein with the purpose to assess the spatial relationships and verify the impact of innovation dynamics on regional re-industrialization processes in Italy ([Calignano, Quarta 2015](#)). However, that study neglected transnational links despite the characteristics of the FPs and the increasing importance played by international collaborations in knowledge exchange leading to innovation and competitiveness ([Asheim, Isaksen 2002](#), [Autant-Bernard et al. 2007](#), [Lagendijk, Lorentzen 2007](#), [Frenken et al. 2009](#), [Fitjar, Rodríguez-Pose 2011a,b](#), [Maggioni, Uberti 2011](#)). The present article enabled us to narrow the gap in this respect.

### 3 Dataset and methodology

The 1523 projects funded under the FP6-SME and FP7-SME were chosen as a dataset for the empirical aspects of this study for several reasons.

In a previous study aiming to assess the processes of re-industrialization and regional disparities in Italy ([Calignano, Quarta 2015](#)) it was already stressed that knowledge dynamics – like those ones encouraged by the collaborations established within the FPs – are only one of the drivers of the industrial development. Consequently, the actual effects of this latter can be equally influenced by other significant factors such as investment funds, infrastructures and human capital. However, as highlighted above, we can confidently assert that knowledge exchange based on collaborations and partnerships is a very reliable relational data to capture innovation dynamics in a spatial perspective (e.g. [Fitjar, Rodríguez-Pose 2011a,b](#)).

Furthermore, other funding schemes are expressly implemented to support the economic agents located in the lagging areas and are likely more attractive than the FPs for the SMEs and PREs located in the peripheral regions. Among these, the EU Structural Funds (SF) are specifically designed to narrow the gap between the more and less developed areas of the EU by offering broad financial support to the organizations located in the disadvantaged regions. The aim of this specific EU regional policy measure is to support projects and initiatives such as “developing infrastructure network, supporting enterprises, investing in education, research and innovation activities as well as in environmental protection programmes” ([Busillo et al. 2010](#) cited in [Barkovic et al. 2013](#)).

A recent study aiming to reveal the effectiveness of the SF precisely in Southern Italy revealed very limited positive effects in terms of employment, population and house prices during the period 2007-2013 ([Ciani, De Blasio 2015](#)) by confirming the findings of other studies detecting the impact of the place-based policies implemented in Italy partially financed with EU money ([Bronzini, De Blasio 2006](#), [Accetturo, De Blasio 2012](#), [Andini, De Blasio 2014](#)).

The relevant findings of the aforementioned studies can be considered complementary to the results of our paper. In fact, by following several previous studies (e.g. [Calignano 2014](#), [Calignano, Quarta 2015](#)), the research projects funded under the FP6 and FP7 enabled us to focus specifically on the collaborative dimension of knowledge dynamics aiming to strengthen the innovativeness within the EU countries. This latter is an aspect that cannot be captured by means of the analysis of the projects funded under the SF for two main reasons: First, the broader scope of the SF (even though “Research and



Innovation” is a relevant theme); and second, the beneficiaries of the financing (i.e. single organizations, not research groups).

Furthermore, other significant factors such as the intrinsic characteristics of the FPs, the research methods we adopted, and the theoretical and empirical aspects outlined in the previous sections pushed us to choose the collaborations created within the two latest FPs as our dataset and enabled us to carry out the study successfully.

First of all, one of the characteristics of the FPs is transcalarity, an element which enables researchers to capture relational and spatial collaboration dynamics among organizations by considering various geographical scales. In our case study intra-regional, extra-regional and transnational ties were considered in order to determine the actual presence, knowledge flows and potential clusters of regions with regard to the Italian SMEs and PREs involved in the FP6-SME and FP7-SME. Specifically, with the term “intra-regional” we refer to collaborations between two organizations of the same constitutional/administrative region (NUTS 2); the term “extra-regional” refers to ties established between organizations of two different regions of the same country; finally, “transnational” relations are those involving pairs of organizations belonging to two different countries.

Secondly, the adoption of a dynamic approach (i.e. considering two distinct periods, 2002-2006 for FP6 and 2007-2013 for FP7) allowed us to analyze all the research projects funded by the EU in a significantly long period and to assess whether important changes occurred with regard to the knowledge flows created by the organizations located in a country throughout the two periods considered.

Thirdly, the projects funded under the FP6-SME and FP7-SME cover a very wide range of traditional and technological sectors and industries (textile, ceramic, agro-food, aquaculture, ICT, chemistry, pharmaceutical, automotive, etc.). As a consequence, this aspect allowed us to assess from a global viewpoint the level of interaction and the related knowledge actually exchanged among SMEs and PREs located in different regions and macro-areas of the country.

Finally, the choice of our dataset is justified by the fact that social proximity ([Boschma 2005](#)) and temporary and direct contacts ([Torre 2008](#)) seem to be more relevant than mere geographical proximity in the EU innovation networks created under the FPs ([Calignano 2014](#)).

The findings of these studies suggested that innovation primarily takes place in global innovation networks or innovation systems and that we can look confidently at the ties established by organizations within the EU research network to understand how knowledge exchange dynamics work globally in a country from a spatial and relational viewpoint.

With specific regard to Italy, other studies have revealed how the success rate of the Italian proposals in the European context was one of the highest in absolute terms ([Silvani 2010](#)). Moreover, Italian organizations consider EU funds to be one of the most important sources of research financing by virtue of the greater freedom of action and the high availability of grants and financial resources if compared with the scarce funds allocated at the national level ([Calignano 2014](#)). Even though the latter information refers to a different FP – the Nanosciences, Nanotechnologies, Materials and New Production Technologies – on the basis of the current socio-economic scenario ([ISTAT 2013b](#), [Svimez 2015](#)) we can confidently assert that the same motivations also pushed the Italian entrepreneurs and scientists to apply for the two latest FPs expressly created for the benefits of SMEs.

From an operational viewpoint, following the theoretical premises and empirical evidences previously outlined we have analyzed all the projects funded under the FP6-SME and FP7-SME in order to reconstruct the knowledge flows created and strengthened by the Italian SMEs and PREs. We have specifically focused on those projects with at least one Italian participant. Then, we grouped the partners of each project into pairs checking whether each pair belonged to the same region, different regions or different countries (corresponding to intra-regional, extra-regional and transnational collaboration networks). By following this method and adopting descriptive statistics and cluster analysis we were able to determine if most of the partnerships were gathered inside one macro-area or between different macro-areas of the country, as well as the connections established by the regional organizations at the transnational level and the presence of clusters including regions characterized by similar spatial behavior.

#### 4 Italian organizations in the FP6-SME and FP7-SME

In the next four sub-sections the percentage of participation by Italian SMEs and PREs in the FP6-SME and FP7-SME will briefly be analyzed in comparison with the other countries actively involved in the two latest FPs and with consideration for the differences found at the regional level (4.1). Furthermore, the intra-regional and extra-regional ties (4.2) and the transnational connections (4.3) established by Italian SMEs and PREs will be revealed in the following two sub-sections, with the aim to show in which areas of the country the knowledge flows fostered by the two latest FPs were mainly concentrated. Finally, in Section 4.4 the Italian regions will be clustered on the basis of the number of their intra-regional, extra-regional and transnational links (i.e. the three aggregated variables which allow us to reveal the presence of clusters based on the spatial behavior of the regional organizations located in Italy).

##### 4.1 Italian participation at the national and regional levels

The proportion of participation at the national level was calculated with the aim to reveal the ranking of Italy in comparison with other countries actively involved in the FP6-SME and FP7-SME, and in order to assess whether significant changes occurred in transition from the first to the second period considered.

Table 1 shows the top 10 countries in terms of participation as concerns the FP6-SME and FP7-SME. With the term “participation” we refer to the presence of each country’s organizations without considering the number of organizations actually involved. And as each organization may participate more than once, we use the term “participations” to refer to the amount of times organizations participated in the aforementioned programs.

Table 1: Participation in the FP6-SME and FP7-SME: National level. Calculated from the Cordis dataset (European Commission 2015).

| Ranking |                | FP6-SME    |               |                | FP7-SME    |              |
|---------|----------------|------------|---------------|----------------|------------|--------------|
| 1       | United Kingdom | 823        | 14.40%        | Spain          | 1406       | 15.40%       |
| 2       | Germany        | 767        | 13.40%        | United Kingdom | 1352       | 14.80%       |
| 3       | Spain          | 719        | 12.60%        | Germany        | 945        | 10.30%       |
| 4       | <b>Italy</b>   | <b>581</b> | <b>10.20%</b> | <b>Italy</b>   | <b>829</b> | <b>9.10%</b> |
| 5       | France         | 342        | 6.00%         | France         | 471        | 5.10%        |
| 6       | Netherlands    | 267        | 4.70%         | Greece         | 370        | 4.00%        |
| 7       | Poland         | 222        | 3.90%         | Netherlands    | 329        | 3.60%        |
| 8       | Norway         | 172        | 3.00%         | Norway         | 326        | 3.60%        |
| 9       | Austria        | 161        | 2.80%         | Belgium        | 285        | 3.10%        |
| 10      | Sweden         | 161        | 2.80%         | Sweden         | 244        | 2.70%        |

Generally speaking, out of the top-10 most active countries both in the FP6-SME and FP7-SME, 8 countries confirmed their presence (e.g. Spain, United Kingdom, Germany, Italy, France, Netherlands, Norway and Sweden). The main difference between the two FPs concerns the ranking of Spain, which passed from the third to the first position by overcoming two big and important countries, namely the United Kingdom and Germany. Another significant difference is the presence of Greece and Belgium in the more recent FP: This is due to their increased amount of participation and the simultaneous decrease of Polish and Austrian participation (the two countries ranked in the top-10 in the FP6).

Italy is ranked fourth in both FPs and – even though the percentage of Italian participation decreased (-1.1% in the transition from the FP6-SME to the FP7-SME) – it can be certainly considered as one of the most active countries in absolute terms and one of the countries that profited most from the funds allocated under the FP6-SME and FP7-SME. However, the participation of Italian SMEs and PREs was not the same in the various regions and macro-regional areas throughout the two latest FPs. As highlighted in the following maps (Figure 1), the greatest amount of participation is concentrated in the northern and, to a lesser extent, in the central regions of the country. In fact,



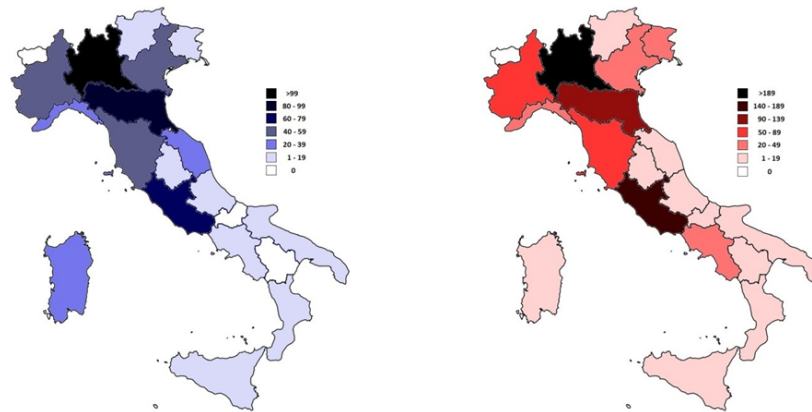


Figure 1: Participations of Italian SMEs and PREs in the FP6-SME (left) and FP7-SME (right): Italian regions. Calculated from the Cordis dataset ([European Commission 2015](#)).

aggregating the data at the macro-regional level reveals that 64.7% of participations in the FP6 and 61.2% in the FP7 were concentrated in the northern areas of the country. Lombardy is the leading region in both FPs (123 participations in the FP6 and 238 in the FP7), followed by Emilia Romagna (80 participations in the FP6 and 106 in the FP7) and Lazio (75 participations in the FP6 and 143 – ranked second before Emilia-Romagna – in the FP7)<sup>2</sup>. The number of participations of SMEs and PREs located in Southern Italy is very limited if compared with the other two macro-regional areas of the country: Only 9.6% of participations in the FP6 and 9.4% in the FP7 saw the presence of the organizations located in the southern regions. All the southern regions are ranked in the lower range (1-19 participations) in both FPs, with the only exceptions being Sardinia in the FP6 and Campania in the FP7, both of whose participations were slightly higher than the lower range (respectively 23 and 21 participations).

The number of Italian SMEs and PREs participating in the FP6-SME and FP7-SME per 1,000 firms was calculated in order to "weigh" the absolute number of regional participations on the basis of the actual number of SMEs with fewer than 250 employees operating in each region. Table 2 shows similar results if compared with the previous maps related to the participation of Italian organizations in absolute terms (Figure 1) by highlighting that only northern and central regions scored above the national average.

#### 4.2 Knowledge flows inside and between the Italian regions and macro-regional areas

After revealing the degree of activity of Italy and the level of participation of the organizations belonging to the various Italian regions and macro-regional areas, a dynamic approach was used to assess the knowledge flows created by the Italian SMEs and PREs at the intra-regional, extra-regional and transnational levels throughout the FP6-SME and FP7-SME.

First of all, the number of intra-regional and extra-regional ties established by the Italian SMEs and PREs throughout the FP6-SME and FP7-SME were calculated (illustrated in Table 3). The two Italian regions with the highest number of intra-regional links in the FP6-SME were Lombardy and Emilia Romagna (respectively 117 and 83): These intra-regional ties represented 50% of the intra-regional links at the national level and revealed an absolute concentration in the two aforementioned regions. The third

<sup>2</sup>Each sheet regarding the projects funded under the FP6 and FP7 is available on the website of the CORDIS (Community Research and Development Information Service) and contains information about the single organizations participating in the projects. This information includes the address of the organization, the administrative contact and their telephone number. The address of the public national research centers (e.g. the Consiglio Nazionale delle Ricerche – National Research Council) refers always to the central headquarters in Rome (Lazio), even though the administrative contacts and their related telephone numbers refer to the person and the separate branch actually involved. The risk to overestimate the number of participations of Lazio was prevented by reconstructing the branch actually involved in the projects by means of a thorough search on Google based on the names of the administrative contacts and their related telephone numbers.

Table 2: Participation of Italian SMEs and PREs in the FP6-SME and FP7-SME per 1000 SMEs: Italian regions. Calculated from the Cordis dataset ([European Commission 2015](#)); and Industry Services Census ([ISTAT 2011](#)).

| FP6-SME                      |               |                            | FP7-SME                      |               |                            |
|------------------------------|---------------|----------------------------|------------------------------|---------------|----------------------------|
| Region                       | Macro area    | Participants per 1000 SMEs | Region                       | Macro area    | Participants per 1000 SMEs |
| <i>Liguria</i>               | <i>North</i>  | <i>0.27</i>                | <i>Lazio</i>                 | <i>Center</i> | <i>0.34</i>                |
| <i>Emilia-Romagna</i>        | <i>North</i>  | <i>0.22</i>                | <i>Liguria</i>               | <i>North</i>  | <i>0.3</i>                 |
| <i>Umbria</i>                | <i>Center</i> | <i>0.2</i>                 | <i>Lombardy</i>              | <i>North</i>  | <i>0.29</i>                |
| <i>Lazio</i>                 | <i>Center</i> | <i>0.18</i>                | <i>Emilia-Romagna</i>        | <i>North</i>  | <i>0.29</i>                |
| <i>Friuli-Venezia Giulia</i> | <i>North</i>  | <i>0.17</i>                | <i>Friuli-Venezia Giulia</i> | <i>North</i>  | <i>0.25</i>                |
| <i>Marche</i>                | <i>Center</i> | <i>0.16</i>                | <i>Tuscany</i>               | <i>Center</i> | <i>0.21</i>                |
| <i>Tuscany</i>               | <i>Center</i> | <i>0.15</i>                | <i>Piedmont</i>              | <i>North</i>  | <i>0.19</i>                |
| <i>Lombardy</i>              | <i>North</i>  | <i>0.15</i>                | <b>Italy (Nat. Av.)</b>      | <b>-</b>      | <b>0.18</b>                |
| <i>Veneto</i>                | <i>North</i>  | <i>0.15</i>                | Trentino-Alto Adige          | North         | 0.17                       |
| <i>Trentino-Alto Adige</i>   | <i>North</i>  | <i>0.14</i>                | Umbria                       | Center        | 0.16                       |
| <b>Italy (Nat. Av.)</b>      | <b>-</b>      | <b>0.13</b>                | Molise                       | South         | 0.14                       |
| Piedmont                     | North         | 0.12                       | Basilicata                   | South         | 0.11                       |
| Sardinia                     | South         | 0.12                       | Apulia                       | South         | 0.08                       |
| Apulia                       | South         | 0.04                       | Veneto                       | North         | 0.08                       |
| Calabria                     | South         | 0.04                       | Abruzzo                      | South         | 0.07                       |
| Abruzzo                      | South         | 0.03                       | Sardinia                     | South         | 0.07                       |
| Campania                     | South         | 0.03                       | Campania                     | South         | 0.06                       |
| Sicily                       | South         | 0.03                       | Marche                       | Center        | 0.06                       |
| Basilicata                   | South         | -                          | Calabria                     | South         | 0.04                       |
| Molise                       | South         | -                          | Sicily                       | South         | 0.03                       |
| Aosta Valley                 | North         | -                          | Aosta Valley                 | North         | -                          |

region at the national level was Sardinia, even though the southern region did not confirm the result in the following FP7-SME, passing from 38 intra-regional links established in the FP6-SME to only 5 links (on the same low level as the other southern regions). Moreover, Lombardy (87 intra-regional links) confirmed its first position in the FP7-SME, followed by Lazio (81, the highest increase in absolute terms in the transition between the two FPs) and Emilia Romagna (52). The number of intra-regional links in the southern macro-regional area was very limited: Only 51 links were found in the FP6-SME and 23 in the FP7-SME (25% and even 7.5% of the total, respectively).

Extra-regional links showed similar figures. In fact, Lombardy confirmed its first position in both FPs (217 links in the FP6-SME and 189 in the FP7-SME), followed by Lazio (respectively 121 and 132) and Emilia-Romagna (respectively 123 and 127). The higher number of extra-regional collaborations in the FP7 compared with the FP6 found in Lazio and Emilia-Romagna did not reflect the results showed by most Italian regions. For instance, central and northern regions such as Tuscany and Veneto more than halved the number of extra-regional collaborations in the transition from the first to the second period considered (passing respectively from 122 to 50 and from 107 to 42). The results of the southern regions were once again disappointing: The higher number of extra-regional links in southern Italy was found in Campania (38 in the FP6-SME and 24 in the FP7-SME, which are 17.5% and 12.6% of Lombardy, the region ranked first).

Following the same method, we aggregated data related to intra-regional links at the macro-regional level with the purpose to reveal inside and between which macro-areas of the country collaborations encouraged by the two latest FPs mainly occurred.

The next two diagrams (Figure 2) show graphically the knowledge exchange involving SMEs and PREs located in the three macro-areas of the country. Specifically, the dimension of the spheres indicate the number of links established by the Italian organizations within their macro-areas; the thickness of the lines illustrates the number of links between two different macro-areas (the thicker the line is, the greater the ties' intensity); and the

Table 3: Intra-regional and extra regional ties in the FP6-SME and FP7-SME: Italian regions. Calculated from the Cordis dataset (European Commission 2015).

| Region                | Macro area | Intra-regional links |            |            |            | Extra-regional links |            |            |            |
|-----------------------|------------|----------------------|------------|------------|------------|----------------------|------------|------------|------------|
|                       |            | FP6 SME              | %          | FP7 SME    | %          | FP6 SME              | %          | FP7 SME    | %          |
| Abruzzo               | South      | -                    | -          | -          | -          | 5                    | 0.5        | 10         | 1.2        |
| Aosta Valley          | North      | -                    | -          | -          | -          | -                    | -          | -          | -          |
| Apulia                | South      | 5                    | 1.3        | 6          | 2.0        | 13                   | 1.3        | 20         | 2.5        |
| Basilicata            | South      | -                    | -          | 1          | 0.3        | -                    | -          | 6          | 0.7        |
| Calabria              | South      | 1                    | 0.3        | 3          | 1.0        | 8                    | 0.8        | 3          | 0.4        |
| Campania              | South      | 3                    | 0.8        | 8          | 2.1        | 38                   | 3.7        | 24         | 3.0        |
| Emilia-Romagna        | North      | 83                   | 20.8       | 52         | 17.1       | 123                  | 11.8       | 127        | 15.8       |
| Friuli-Venezia Giulia | North      | 7                    | 1.8        | 3          | 1.0        | 30                   | 2.9        | 32         | 4.0        |
| Lazio                 | Center     | 26                   | 6.5        | 81         | 26.6       | 121                  | 11.6       | 132        | 16.4       |
| Liguria               | North      | 11                   | 2.8        | 10         | 3.3        | 84                   | 8.1        | 57         | 7.1        |
| Lombardy              | North      | 117                  | 29.3       | 87         | 28.6       | 217                  | 20.9       | 189        | 23.4       |
| Marche                | Center     | 22                   | 5.5        | 1          | 0.3        | 33                   | 3.2        | 12         | 1.5        |
| Molise                | South      | -                    | -          | -          | -          | -                    | -          | -          | -          |
| Piedmont              | North      | 12                   | 3.0        | 19         | 6.3        | 51                   | 4.9        | 51         | 6.3        |
| Sardinia              | South      | 38                   | 9.5        | 5          | 1.6        | 20                   | 1.9        | 15         | 1.9        |
| Sicily                | South      | 4                    | 1.0        | 0          | -          | 8                    | 0.8        | 11         | 1.4        |
| Tuscany               | Center     | 29                   | 7.3        | 21         | 6.9        | 122                  | 11.7       | 50         | 6.2        |
| Trentino-Alto Adige   | North      | 4                    | 1.0        | 1          | 0.3        | 31                   | 3.0        | 16         | 2.0        |
| Umbria                | Center     | 9                    | 2.0        | -          | -          | 29                   | 2.8        | 9          | 1.1        |
| Veneto                | North      | 28                   | 7.0        | 6          | 2.0        | 107                  | 10.3       | 42         | 5.5        |
| <b>Total</b>          | <b>-</b>   | <b>399</b>           | <b>100</b> | <b>304</b> | <b>100</b> | <b>1040</b>          | <b>100</b> | <b>806</b> | <b>100</b> |

figure in or in proximity to the spheres indicates the exact number of links established within a macro-area, whereas the figure positioned beside the lines refers to the exact number of links established between different macro-areas.

The number of links decreased drastically both inside the same macro-area and between different ones in the transition from the FP6-SME to the FP7-SME, despite the increased number of Italian participations. These figures depend on the lower number of organizations involved in the projects funded under the FP7-SME if compared to the previous FP (specifically, the average of participants in projects with at least one Italian organization was 13.7 in the FP6 and 11.4 in the FP7). Beyond this general consideration, what we can observe when looking at the links established among SMEs and PREs located in the same or different macro-regional areas is the highest concentration of collaborations in the North (450 links in the FP6-SME and 294 in the FP7-SME) and a good number of collaborations both between the North and the Center (220 links in the FP6-SME and 160 in the FP7-SME) and in the Center (112 in the FP6-SME and 83 in the FP7-SME).

On the other hand, connections in the South (40 in the FP6-SME and 22 in the FP7-SME) and between the South and the other two macro-regional areas were very limited. In this respect, one of the major changes in the transition between the two FPs was the balance of ties established by the SMEs and PREs located in the South with the ones located in the other two macro-regional areas: the South-Center relationship was stronger in the FP6-SME (52 links versus the 35 links established with the North), whereas the South-North connection was stronger in the following period (50 links versus the 24 links established with the Center).

#### 4.3 The transnational links established by the Italian SMEs and PREs

The analysis carried out in the previous section enabled us to determine the intra-regional and inter-regional knowledge flows created by the Italian SMEs and PREs through the projects funded under the FP6-SME and FP7-SME. The figures showed a strong concentration of collaborations in the northern macro-regional area and a very good

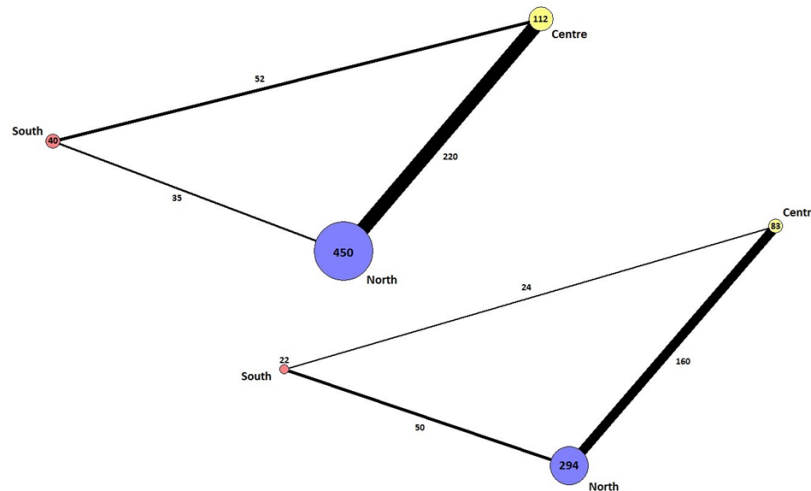


Figure 2: Intra-regional and extra-regional knowledge flows in the FP6-SME and FP7-SME: Italian macro-regional areas. Calculated from the Cordis dataset ([European Commission 2015](#)); and NetDraw Network Visualization ([Borgatti 2002](#)).

number of ties established between organizations located in the northern and central areas of the country, with a shortage of links involving southern SMEs and PREs both at the intra-regional and extra-regional levels.

However, following our theoretical premises, for the intrinsic characteristics of the FPs and considering the purposes of the present study, a further level of analysis regarding transnational collaborations must be added. This type of analysis enabled us to determine the number of transnational collaborations involving the Italian SMEs and PREs and consequently to assess if organizations located in Southern Italy were able to connect themselves to important international nodes, as various studies suggest them to do ([Meier Zu Köcker et al. 2011](#), [Gust-Bardon 2012](#)).

The next table (Table 4) shows in detail the transnational collaborations established by the Italian organizations located in the twenty constitutional regions together with the related percentage. Lombardy showed again the highest scores both in the FP6-SME and FP7-SME (1517 ties, 23% of the total in the FP6, and 1737 ties, 29.6% of the total in the FP7), followed by Lazio (685, 10.5% of the total in the FP6, and 1022, 17.4% in the FP7) and Emilia Romagna (1043, 16% of the total in the FP6, and 716, 12.2% in the FP7). The only other region with a percentage of transnational collaborations higher than 10% was Tuscany (10.1% in the only FP6). All the other regions played the second fiddle with regard to the transnational collaborations established by the SMEs and PREs located within their boundaries

The regional data regarding the transnational collaborations were also aggregated at the macro-regional level in order to reveal in which parts of the country most transnational collaborations were gathered. The figures depicted in the next table (Table 5) show clearly how two thirds of the transnational collaborations involved northern regions both in the FP6-SME and FP7-SME. Once again, a shortage of transnational collaborations was observed especially in the South: Only about 9% of the total links at the national level were established in the southern regions with regard to both the detected FPs.

#### 4.4 The hierarchy of the Italian regions in the FP6-SME and FP7-SME: A Cluster Analysis

The figures deriving from the distinct analysis regarding the intra-regional, extra-regional and transnational collaborations established by the Italian organizations in the two latest FPS were grouped with the purpose to reveal the presence of clusters based on collaborations gathered at various geographical levels. Specifically, intra-regional, extra-regional and transnational collaborations calculated for each Italian region represented the three variables used to determine the presence of clusters based on the characteristics

Table 4: Transnational links in the FP6-SME and FP7-SME: Italian regions. Calculated from the Cordis dataset ([European Commission 2015](#)).

| Region                | Macro-Area | Transnational links |            |             |            |
|-----------------------|------------|---------------------|------------|-------------|------------|
|                       |            | FP6-SME             | %          | FP7-SME     | %          |
| Abruzzo               | South      | 22                  | 0.3        | 42          | 0.7        |
| Aosta Valley          | North      | -                   | -          | -           | -          |
| Apulia                | South      | 107                 | 1.6        | 135         | 2.3        |
| Basilicata            | South      | -                   | -          | 22          | 0.4        |
| Calabria              | South      | 56                  | 0.9        | 50          | 0.9        |
| Campania              | South      | 132                 | 2.0        | 115         | 2.0        |
| Emilia-Romagna        | North      | 1043                | 16.0       | 716         | 12.2       |
| Friuli-Venezia Giulia | North      | 114                 | 1.7        | 159         | 2.7        |
| Lazio                 | Center     | 685                 | 10.5       | 1022        | 17.4       |
| Liguria               | North      | 348                 | 5.3        | 240         | 4.1        |
| Lombardy              | North      | 1517                | 23.3       | 1737        | 29.6       |
| Marche                | Center     | 195                 | 3.0        | 48          | 0.8        |
| Molise                | South      | -                   | -          | 17          | 0.3        |
| Piedmont              | North      | 396                 | 6.1        | 406         | 6.9        |
| Sardinia              | South      | 199                 | 3.1        | 110         | 1.9        |
| Sicily                | South      | 74                  | 1.1        | 63          | 1.1        |
| Tuscany               | Center     | 661                 | 10.1       | 528         | 9.0        |
| Trentino-Alto Adige   | North      | 141                 | 2.2        | 97          | 1.7        |
| Umbria                | Center     | 191                 | 2.9        | 94          | 1.6        |
| Veneto                | North      | 639                 | 9.8        | 261         | 4.5        |
| <b>Total</b>          | <b>-</b>   | <b>6520</b>         | <b>100</b> | <b>5862</b> | <b>100</b> |

Table 5: Transnational links in the FP6-SME and FP7-SME: Italian macro-regional areas. Calculated from the Cordis dataset ([European Commission 2015](#)).

| Macro-area | Transnational links |      |         |      |
|------------|---------------------|------|---------|------|
|            | FP6-SME             |      | FP7-SME |      |
|            | Total               | %    | Total   | %    |
| North      | 4198                | 64.4 | 3616    | 61.7 |
| Center     | 1732                | 26.6 | 1692    | 28.9 |
| South      | 590                 | 9.0  | 554     | 9.4  |

of the participations of the Italian regions in the two latest FPs. From a methodological viewpoint, hierarchical clustering and the nearest neighbor method were preferred and adopted. Specifically, hierarchical clustering enabled us to determine the presence of bottom up clusters based on the actual presence and spatial behaviors of the SMEs and PREs located in each Italian region. In other words, the use of the nearest neighbor algorithm – according to which the distance between two clusters must equal the distance between their two closest members – enabled us to highlight clearly the similarity in the elements making up a cluster. In fact, the nearest neighbor method attributes more importance to the homogeneity among the elements of a group rather than differentiating sharply the various clusters.

The next diagrams (Figure 3) illustrate the major clusters we identified and their features: specifically, the x-axis refers to the number of intra-regional collaborations, the y-axis illustrates the number of extra-regional links, and the dimension of the spheres shows the different number of transnational links (bigger spheres correspond to a higher number of transnational links). Finally, the color of each sphere determines a different cluster. Following the method described above, four different major clusters grouping regions according to the number of their intra-regional, extra-regional and transnational links were

found. With regard to the FP6-SME, Lombardy and Emilia-Romagna correspond to two different major clusters composed of one single region. These two clusters are characterized by a high level of activity as for extra-regional and transnational collaborations (Emilia Romagna) and a higher number of links for each geographical scale considered (Lombardy), even though Lombardy could be undoubtedly considered as the most active region in absolute terms dominating both the FPs at the national level. Behind these two clusters, a third cluster characterized by regions with similar spatial and relational features was formed by five northern and central regions including Lazio, Liguria, Piedmont, Tuscany and Veneto. The main characteristic of this cluster is to be formed by regions with an intermediate level of ties at the various geographical scales. Finally, in the fourth and last cluster all the other regions showing a lower level of interaction were grouped.

The main changes assessed in the transition from the FP6-SME to the FP7-SME regarded the position of Lazio – passed from the third to the second cluster – which formed a new group together with Emilia-Romagna, and the fewer number of organizations making up the third cluster (in the second period formed only by Tuscany and Piedmont). Finally, two regions historically characterized by a strong concentration of industrial activities such as Liguria and Veneto were absorbed by the last cluster. These figures showed an increasing concentration in the level of activity – implying the presence of centralized networks – in only five regions (Lombardy, Lazio, Emilia Romagna, Piedmont and Tuscany) forming 3 out of 4 observed clusters. As a consequence, one very important finding in our study is that all the southern Italian regions belong to the fourth and less active cluster, therefore confirming again the scarce propensity demonstrated by the SMEs and PREs located in the South to create and strengthen strong links at every geographical scale considered.

## 5 Discussions of the major results and conclusions

Starting from the theoretical considerations and empirical evidences regarding the importance for firms located in peripheral areas to cooperate at various geographical levels in order to improve their competitiveness, the present article analyzed the degree of connection of the eight Italian regions making up the southern macro-regional area of the country with the aim to assess if the network structure of the projects funded under the two latest FPs confirmed an agglomeration of innovation activities in the most advanced macro-areas (North and Center) or if they led to more widespread benefits for firms at the national level (Calignano, Quarta 2015).

The choice of SMEs as the object of study was determined by their absolute importance in the Italian economic fabric, which is composed of 99.9% of SMEs (ISTAT 2013a). Furthermore, the projects funded under the FPs were considered the ideal dataset especially for their intrinsic characteristic of transcalarity and the dynamic approach we adopted allowed us to project our findings in a long period (more than ten years) divided in two different lapses of time.

All these theoretical premises and methodological devices applied to the Italian case study enabled us to achieve several interesting findings. First of all, the northern regions and to a lesser extent the central regions dominated the innovation networks created by means of the links established throughout the two latest FPs both in terms of participation and collaborations. Furthermore, the agglomeration of innovation activities in the North and Center macro-regional areas is a phenomenon affecting all the considered geographical scales (intra-regional, extra-regional and transnational). Finally, the cluster analysis confirmed the absolute supremacy (as in the case of Lombardy, Emilia-Romagna and Lazio) and in any cases the central role (Tuscany and Piedmont in both FPs but also Liguria and Veneto in the only FP6) of those regions where industrial activities are traditionally mainly concentrated in Italy (Bagnasco 1977, Trigilia 1986, Scott 1988, Sforzi 1989, A'Hearn, Venables 2011). On the other hand, the figures related to the southern regions showed a very limited number of connections with a related weak knowledge exchange.

Supporting the findings of a previous study carried out in a similar vein (Calignano, Quarta 2015), the answer to the research question we asked in the introductory part of this



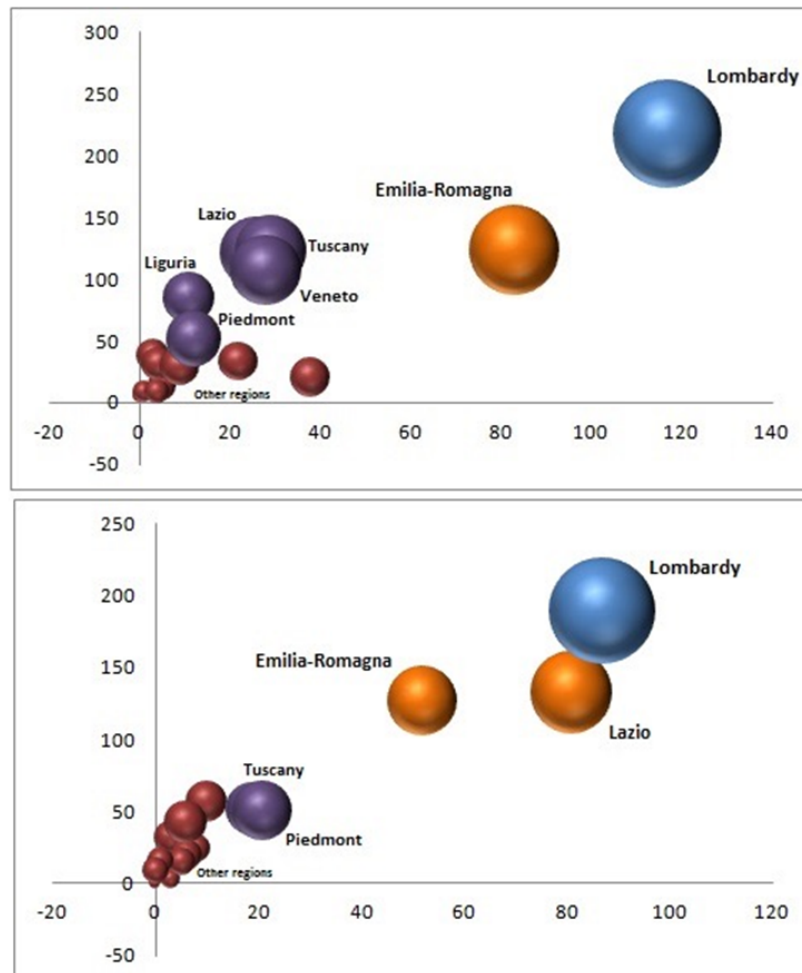


Figure 3: Italian regions clustered on the basis of their intra-regional, extra-regional and international links, FP6 (above) and FP7 (below). Methods: Hierarchical clustering; nearest neighbor method; Euclidean distance. Calculated from the Cordis dataset ([European Commission 2015](#)).

paper is that international networks involving various geographical scales (intra-regional, extra-regional and transnational) are hardly a way for SMEs located in peripheral and marginal area such as southern Italy to increase their competitiveness. They remained on the sidelines of the knowledge flows fostered by the EU innovation networks confirming the very weak level of innovation activities in the southern regions ([ISTAT 2013b](#)) as well as the long lasting disparities observed in the country ([A'Hearn, Venables 2011](#)).

In other words, all the figures revealed by the present paper demonstrated not only that the collaborations established by the Italian organizations at various geographical scales are influenced by the characteristics of the region in which they are located (i.e. dimension, geographical position, presence of PREs and qualified consultants, socio-economic and industrial context, etc.), but especially that the opportunities created by the so-called knowledge-based economy ([Brinkley 2006](#)) and the “open” model of innovation ([Chesbrough 2003](#)) – fostered by the research projects funded under the two latest FPs – did not enable the SMEs and PREs located in southern Italy to narrow remotely the gap with those ones located in the northern and more advanced regions of the country.

Based on several empirical evidences, our study provided reliable policy indications to the administrators and policymakers at the regional and national levels by implying the need of more direct (i.e. R&D financial support) and indirect (i.e. coordination/networking actions) support to the SMEs located in the southern regions. However, following the

theoretical premises outlined in the theoretical section (e.g. [Bathelt et al. 2004](#), [Gust-Bardon 2012](#)), we argue that the Italian regional and national governments should consider especially the need to implement indirect policy measures based on coordination and networking activities aiming to enhance collaborations and partnerships – potentially leading to innovation – at various geographical scales.

Furthermore, the case study we illustrated in the present article has significant implications also for the other academics who are interested in analyzing the regional disparities in a country in terms of innovation and competitiveness. In fact, our study is easily reproducible and can be successfully applied in other countries with similar core-periphery dynamics (e.g. Greater London in the UK or Île-de-France in France) with the aim to compare the Italian framework, draw some wider influences and achieve further relevant results.

Finally, the methodological approach used in this study enabled us to reveal the knowledge flows and the related exchange in terms of knowledge involving the Italian SMEs and PREs at various geographical levels. These are aspects considered to be an essential prerequisite leading to innovation ([European Commission 2013](#), [Calignano, Quarta 2015](#)).

However, our method based on descriptive statistics and cluster analysis did not allow us to investigate several other important aspects. Among these, the main motivations – besides the lack of financial resources allocated at the national level – which have pushed the Italian entrepreneurs and researchers to apply, the role played by other dimensions of proximity ([Boschma 2005](#)) in the building of the research groups throughout the FP6-SME and FP7-SME, and especially the impact of the FPs' collaborations in terms of actual innovation outputs and scientific and economic effects at the regional and national level ([Calignano 2014](#)).

For this reason, further studies carried out by adopting qualitative methods (e.g. in-depth interviews) are needed in order to answer these critical research questions and to offer a wider perspective.

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